ISSN 0704-3716

Canadian Translation of Fisheries and Aquatic Sciences

No. 5141

Biology and exploitation of the White Sea harp seal population

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Original title: Biologiya i promysel belomorskoi populyatsii grenlandskogo tyulenya

In: Morskie mlekopitayushchie. "Nauka" Publishing House, Moscow, U.S.S.R., p. 109-117, 1984

Original language: Russian

Available from:

Canada Institute for Scientific and Technical Information
National Research Council
Ottawa, Ontario, Canada K1A 0S2

1985

13 typescript pages

Fisheries & Oceans
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MULTILINGUAL SERVICES DIVISION – DIVISION DES SERVICES MULTILINGUES

TRANSLATION BUREAU BUREAU DES TRADUCTIONS

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Translated from - Traduction de	Into - En
RUSSIAN	ENGLISH

Author - Auteur
Yu.I. Nazarenko

Title in English or French - Titre anglais ou français
Biology and exploitation of the White Sea harp seal population

Title in foreign language (Transliterate foreign characters)
Titre en langue étrangère (Transcrire en caractères romains)
Biologiya i promysel belomorskoi populyatsii grenlandskogo tyulenya

Reference in foreign language (Name of book or publication) in full, transliterate foreign characters.
Référence en langue étrangère (Nom du livre ou publication), au complet, transcrire en caractères romains.
Morskie mlekopitayushchie

Reference in English or French - Référence en anglais ou français
Marine mammals

Publisher - Éditeur	DATE OF PUBLICATION / DATE DE PUBLICATION			Page Numbers in original / Numéros des pages dans l'original
Nauka	Year / Année	Volume	Issue No. / Numéro	109-117
Place of Publication / Lieu de publication				Number of typed pages / Nombre de pages dactylographiées
Moscow, USSR	1984			13

Requesting Department / Ministère-Client: DFO

Branch or Division / Direction ou Division: SIPB

Person requesting / Demandé par: J. Saunders, Dartmouth

Your Number / Votre dossier nº:

Date of Request / Date de la demande: February 11th, 1985

Translation Bureau No. / Notre dossier nº: 1655860

Translation (Initials) / Traducteur (Initiales): GM

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

MAR 26 1985

SEC 5-111 (81/01)

Secretary of State | Secrétariat d'État

MULTILINGUAL SERVICES DIVISION – DIVISION DES SERVICES MULTILINGUES

TRANSLATION BUREAU | BUREAU DES TRADUCTIONS

Client's No.–N° du client	Department – Ministère	Division/Branch – Division/Direction	City – Ville
	DFO	SIPB	Dartmouth
Bureau No.–N° du bureau	**Language – Langue**	**Translator (Initials) – Traducteur (Initiales)**	
1655860	Russian	GM	MAR 2 6 1985

Source: Morskie mlekopitayushchie (Marine mammals), publ. by "Nauka," Moscow, 1984, pp.109-117.

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UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

Russian source: Morskie mlekopitayushchie.
Moscow: "Nauka", 1984, pp. 109-117

UDC 639.247.453

BIOLOGY AND EXPLOITATION OF THE WHITE SEA HARP SEAL POPULATION

Yu.I. Nazarenko

The harp seal (Pagophilus groenlandicus) is the most numerous representative of the Phocidae family in the northern hemisphere. Its range extends from the shores of the Canadian Arctic in the west to the islands of Severnaya Zemlya in the east. Within these boundaries the harp seal forms three isolated populations based on habitat and biology : Newfoundland, Jan Mayen and White Sea. The White Sea population, which lives in the territorial waters of the USSR, is subject to consistent intensive exploitation.

The harp seal is, perhaps, the most typical pagophile, and most of them are associated directly with ice all year round. Nevertheless, more than once we have discovered them in completely clear water in summer, more than 100 km from the nearest ice. Cases are known where individuals have been found on dry land far from the shore, having lost their sense of direction crossing the ice during prolonged and dense compaction of the ice. Young animals - bedlamers - sometimes find their way upriver, e.g. up the North Dvina.

The growth of the harp seal continues until physical maturity, which is reached at the age of about 10 years. The body of the adult

weighs up to 200 kg, the weight being governed not so much by age as by seasonal factors (better condition between the end of autumn and beginning of spring). Almost half the weight is due to the skin and blubber. There is no distinct sexual dimorphism, but the total weight of the males is somewhat greater than that of the females and this is apparent in all age groups. (Table 1).

An important characteristic of the harp seal as opposed to other pinnipeds is its pronounced tendency to migrate. It spends almost its entire life on the move, either in the water among the ice or drifting along passively with the moving pack ice. In autumn the seals make their way from the edge of the polar ice southward into the White Sea, where separate groups appear in December. Their number gradually grows and at the end of February they form breeding areas in the northeast part of the basin which include all the breeding females. By the middle of March adult males are already to be found in the vicinity of these breeding areas.

Impelled by permanent currents and winds, the ice drifts through the Gorlo and Voronka straits and into the south part of the Barents Sea. Here the seals begin to move independently into the north part of the sea to the summer polar ice edge, where they disperse over a large area stretching from Spitsbergen to Severnaya Zemlya. Here they spend their time feeding in the summer and autumn, preferring to keep in small groups of 10-30. They enter the bays and fiords of the Scandinavian coast, usually among the islands of the Franz Josef Land archipelago. Cases are known where unusual ice and weather conditions carrying the ice westward have left large numbers of bedlamers stranded in the White Sea near the coastline, where they have gradually perished. The last years when this happened were 1966 and 1979.

Initially the breeding areas are quite small and the animals lie close together. Subsequent drifting intersperses empty ice and the seals are scattered over a wider area. In the Barents Sea the only observable trend is active movement northward.

The males become sexually mature after the age of 4, whereas the females can mate at 3. However, only a small proportion of the animals (up to 10%) are mature by this age and it is 7-8 years before the entire contingent has mated. Most of the females mate for the first time at the age of 5-6. Pregnancy lasts for about 11 months, and the development of the embryo includes a latent period of 3-4 months. Birth takes place on the ice and there is generally only one pup. Two is an extremely rare occurrence. The newborn pup weighs 7-10 kg and is covered with long greenish-yellow hair which rapidly turns white and is then replaced by a second coat. The pups feed only on their mother's milk. The mother is very solicitous and uneasy, and she will not feed another mother's pup. In twenty-four hours the pup puts on up to 2 kg owing to the high fat content of the milk (up to 48%). At first the pup feeds frequently but only takes a comparatively small meal - up to 500 grams - each time. With increasing age the meals become larger but less frequent. The milk diet ends about 3 weeks after birth, by which time the pup weighs over 25 kg. When they have eaten their fill the "whitecoats" lie quietly and spend most of their time asleep in the shelter of a ropak or ice floe. The sex ratio among the newborn is 1:1. Virtually all the gravid females give birth between February 27th and March 5th.

Rut begins in March in the pupping areas, and many of the females continue to feed their young. There are usually vicious fights between the males. The harp seal is not polygamous, but nor is it strictly

monogamous, since the female may mate with several males, just as the male may mate with more than one female. Mating occurs on the ice, but perhaps more frequently in the water. Rut ends in early April. During this period the animals become much thinner and lose up to 50% of their weight. So-called "starvelings" can often be found in the pupping and later the moulting areas. These are pups that the female for some reason or other did not feed. Their development is retarded and they may perish; but often they survive, though they remain undersized and evidently incapable of breeding later on.

In April all the seals except for the young of the year haul out onto the ice and form the so-called moulting patches, which are usually situated in the Voronka Strait and in the south part of the Barents Sea. The moulting patches are characterized by high density of the seals which frequently lie side by side. During this period the animals lie out on the ice for days on end and even sink into it as it melts. If they are not disturbed the patches may remain intact for weeks. The ice is covered all over with scales of moulted skin. If it rains or snows, the animals quickly enter the water. The age and sex structure of the seals in the moulting areas reveals a distinct pattern. At first there are only adult males on the ice, then, after April 20th, adult females and immatures of both sexes arrive. It is usually considered that at the end of April-beginning of May virtually the entire population except for the young of the year is concentrated in these areas. This rule, notwithstanding some exceptions, seems on the whole to be fairly close to reality.

As shown by investigations of the reproductive organs, there is more sterility among adult parous females, which may reach 25%. It increases in the animals of the older groups. In general, however,

sterility may be regarded as a physiologically necessary periodic rest for the female organism after great stress (mating, annual pregnancy, parturition, suckling and so on). Hence such intervals of rest are bound to be more frequent in the older age classes.

The surprisingly high increase in the body weight of the pups during suckling stops as soon as lactation ceases. For a time the moulting pups lying out on the ice stop feeding, gradually accustom themselves to the water, and learn how to swim and dive. The scattered individuals form large groups and clusters and prefer to keep to the edge of the ice. All this time they are losing weight and the bedlamers normally weigh less than the moulting whitecoats (khokhlusha A and B).]No explanation of the term khokhlusha found, but the word khokhol from which it derives means 'crest'(Translator)].

According to received wisdom, the enemies of the harp seal are the killer whale, the Greenland shark and the polar bear. However, there is scarcely any hard evidence to show that the seals have been killed by these animals, and the entire idea is born of logic or isolated random facts. It must be remembered that the polar bear is a threat only on the ice, whereas the seal spends most of the summer and fall in the water where the bear presents no danger. During the rest of the year the seals are far from the usual haunts of the polar bear. To escape from the shark or whale the seal can always haul out on the ice where it is quite safe. The newly born pup may be endangered by arctic and other foxes and wolves roaming over the ice, and to a lesser extent by large birds (gulls, crows, ravens) flying inshore. The most serious natural threat to the White Sea harp seal population comes from ice hummocking during periodic tidal and wind-induced compression in

all parts of the White Sea and especially in the Mezen' Inlet region, as well as on banks and spits. However, it is next to impossible to count the animals killed because they are buried by the ice. Observations are conducted practically every year to determine the number of seal deaths from this cause. Even the entry into the water of quite small pups cannot be a cause of death since they climb out onto the ice fairly quickly and without any help. Due to the growth of winter shipping, convoys of large ships in the White Sea have to be piloted in such a way as to avoid the breeding grounds, otherwise not only would the peace be disturbed, which is already bad enough, but large numbers of young seals would also be killed.

As far as parasites are concerned, practically every seal is infested with water lice which are especially numerous on bedlamers in spring. In the course of the year the gastro-intestinal tract of all the animals becomes infested in varying degrees with helminths. The seals exhibit no constant well-defined diseases, although they may themselves infect people with infectious chronic monoarthritis (a dangerous disease of the joints) when the infection is transmitted via punctures or cuts.

The harp seal has no serious competitors for its food since it spends its main feeding period in the northern regions of the Barents and Kara seas where other marine mammals are comparatively few in species and numbers. The diet of the seal is quite varied and includes many species of crustaceans and different species of fish - arctic cod, capelin, herring, pollock, ocean perch, halibut, flounder, sculpin. Feeding throughout the year is fairly irregular, For example, the seal hardly eats at all, or only at random, during breeding and moulting.

In recent years the question of feeding by the harp seal and its impact on the stocks and runs of commercial fishes has become very acute. Things have gone so far that proposals have been published for reducing the size of the seal population in order to increase the fish catch. This argument is based on an elementary and seemingly incontrovertible calculation: one seal eats roughly 5 kg of food a day, which when extrapolated to the whole population gives an astronomical figure on the order of millions of tons a year. Without making a detailed analysis it must be said that the calculation is oversimplified and one-sided, since it ignores many points and evades the main issue. Notwithstanding the pressing nature of the "seal versus fish" question, we do not have any factual data on the damage done by seals to the fishing industry. It has been noted that most seals harvested have empty stomachs, and this includes animals that have been killed in the water and opened up straight away. When discussing the problem, account should be taken of the role played by seals in culling weak, diseased and old fish. On the whole the seal helps to stabilize natural marine ecosystems.

The factual data gathered in recent years show that young seals feed only on crustaceans, and it is not until later that they devour fish systematically. The stocks of the main food fishes consumed by seals (arctic cod and capelin) are not yet threatened, although these species are becoming much more important commercially. Thus, even a brief impartial examination of the issues fails to produce any evidence to support the sweeping accusation that feeding by seals is responsible for declining fish catches. p. 114

The White Sea harp seal may in many ways be a suitable subject for experimentation with different management practices, altering rates of

exploitation, implementing various protective measures, testing new vessels and processing technologies, trying out new equipment, organizing scientific investigations, achieving some measure of international cooperation in scientific studies and the exploitation of the population, etc.

The harp seal fishery in the White Sea is a very old one and was conducted on a serious commercial scale as long ago as the 12th century along the north coast of Europe. This was due to the following factors: the range and great value of the products obtained, the comparative simplicity of the sealing operations, proximity to centres of commerce and population, the experience of the Pomory [name given to the descendants of the early settlers who colonized the southeastern and southwestern shores of the White Sea (Translator)], the possibility of using different types of boat, and the [nature of] the coast. These factors still apply, and their importance has even grown. They have produced tried and trusted traditions and generations of experienced skilled workers. Later the harp seal attracted the attention of Norwegian sealers as well who began to hunt in the south part of the Barents Sea and then in the White Sea as far as the island of Morzhovets, becoming in the course of time serious competitors to the Russians in all respects.

A steady increase in the number of sealing ships, the use of ice breakers and aircraft, the virtual non-existence of any limits on the size of the catch all allowed the industry to expand until it reached its peak in 1920-1935, when the annual harvest was over 200,000 and as much as 500,000 in some years (Table 2).

Quite naturally the seal population could not endure the pressure for long and went into a sharp decline which affected the fishery so

severely that, in spite of all attempts to expand, it began to decline until by the beginning of the fifties the harvest barely reached 100,000 head a year. The Great Patriotic War brought an enforced partial respite for five years which allowed the population to recover slightly so that the annual catch remained steady at 150,000. But even this reduced pressure was too much for the seal population and after 1960 there was another decline in yield. There is scientific evidence to show this.

Scientific research organizations undertook comprehensive large-scale studies to provide a convincing description of the state of the stock and protect it from extinction. This included biological research and frequent aerial censuses. Finally decisive measures were taken in 1965 to provide for the recovery of the stock. The size of the catch was reduced and strict quotas of 20,000 for the USSR and 12,000 for Norway were introduced. At the same time the approach to exploitation was altered: a total ban was placed on the catching of adult females in the breeding areas and the greater part of the allowable catch was restricted to the young of the year (whitecoats, bedlamers). This p. 116 strict regime was maintained for 10 years, and only after objective data, including biological evidence, had been obtained to show that the population had begun to increase was the limit raised slightly to 50 thousand head. But what sort of data were accepted as evidence of an improvement? The biological case was based chiefly on the age and sex structure of the kills. There was a clear trend towards an increase in the number of older animals, and the imbalance between females and males, resulting from a certain degree of hunting selectivity over many years, was disappearing (Table 3).

On examining the census data we find that the aerial survey method has always been the same in recent years. A continuous survey is made of all the breeding areas along parallel flight tracks and then a head count is made.

In recent years surveying has been restricted to the whelping areas and only the breeding females have been counted (Table 4). For several years now field studies have been conducted to determine the size of the correction factor (the number of females in the water at the time of the survey). According to census data, the annual stock increment is about 5%, which is high.

As shown by the example of the harp seal, only the most decisive measures unrelentingly applied over a period of 7-10 years produce results, whereas half-measures, practised more often than not for only 3-5 years, are inadequate.

We envisage for the future a form of exploitation which will ensure further consolidation of the population, safeguard it against any eventuality, and produce the maximum yield. The main emphasis in research will be on questions of biology and particularly feeding, and for that reason it may prove possible to make certain adjustments to the size of the quota, though it appears doubtful whether the fishery can be expanded on this basis.

Table 1. Size (zoological length) of the harp seal (in cm)

Age, years	females		males	
	Limit	Average	Limit	Average
whitecoat	73—130	108,4	87—130	108,9
1	—	130,0	130—150	138,1
2	142—157	149,5	152—169	161,0
3	160—165	162,5	158—172	165,0
4	151—192	177,7	166—182	174,4
5	160—195	180,1	170—191	180,9
6	158—202	181,0	162—196	184,7
7	158—207	183,0	170—207	186,5
8	165—203	183,6	162—201	188,6
9	165—200	184,4	161—205	189,3
10	166—203	184,5	181—203	192,9

Table 2. White Sea harp seal catch (by year, number of head)

Year	Norway	USSR	Total	Year	Norway	USSR	Total
1875	8 458	21 346	29 804	1930	149 922	157 700	307 622
1876	9 076	28 435	37 511	1931	107 708	142 700	250 408
1877	6 344	48 436	54 690	1932	137 891	117 400	255 291
1878	5 856	29 244	35 100	1933	150 562	102 100	252 662
1879	5 615	37 886	43 501	1934	65 002	155 500	220 502
1880	8 384	19 315	27 699	1935	47 156	197 800	244 956
1881	3 134	8 960	12 094	1936	42 696	168 900	211 596
1882	5 893	15 663	21 502	1937	19 749	163 584	183 333
1883	9 254	58 326	67 580	1938	46 900	30 000	76 900
1884	19 845	37 846	57 691	1939	34 073	104 000	138 073
1885	9 858	12 406	22 264	1940	—	10 100	10 100
1886	16 969	12 916	29 885	1941	—	131 800	131 800
1887	22 746	13 025	35 771	1942	—	2 700	2 700
1888	21 222	32 985	54 207	1943	—	33 100	33 100
1889	15 888			1944	—	22 200	22 200
1890	21 051	17 220	38 271	1945	—	85 200	85 200
1891	26 246	19 824	46 070	1946	8 963	79 100	87 663
1892	30 293	17 403	47 696	1947	6 616	161 100	167 716
1893	24 148	40 717	64 865	1948	8 926	164 300	155 226
1894	28 950	13 326	42 276	1949	25 067	183 477	208 444
1805	32 995	26 593	59 588	1950	17 727	194 768	212 495
1896	27 099	59 643	86 742	1951	33 813	192 493	226 306
1897	34 978	59 560	94 538	1952	19 148	131 600	150 748
1898	36 957	74 469	111 426	1953	12 444	88 638	101 082
1899	36 213	54 344	90 557	1954	11 648	152 200	163 848
1900	38 210	37 060	75 270	1955	19 068	98 200	117 268
1901	58 665	37 180	95 845	1956	25 155	68 300	93 455
1902	78 932	64 584	143 516	1957	22 334	107 876	130 210
1903	65 972	19 341	85 313	1958	15 129	112 992	128 121
1904	32 506	26 800	59 306	1959	8 543	98 284	106 827
1905	53 358	21 666	75 024	1960	10 694	93 115	103 809
1906	42 619	19 223	61 842	1961	11 157	93 811	104 968
1907	66 161	21 440	87 601	1962	8 306	119 660	127 966
1908	65 712	19 921	85 633	1963	13 349	69 496	82 845
1909	103 025	25 637	128 662	1964	14 586	62 778	77 346
1910	106 959	22 986	129 945	1965	6 436	20 632	27 068
1911		36 280		1966	12 251	20 012	32 263
1912	84 547	50 263	134 810	1967	11 562	20 000	31 652
1913	85 789	67 213	153 002	1968	15 110	20 033	35 143
1914	108 024	27 696	135 720	1969	11 937	22 105	34 042
1915	118 358	50 000	168 358	1970	12 964	25 590	38 554
1916	91 914	40 000	131 914	1971	8 624	27 668	36 292
1917	74 921	37 262	112 183	1972	12 438	31 135	43 573
1918	99 353	28 000	127 353	1973	12 318	30 763	43 081
1919	113 737	34 000	147 734	1974	7 377	29 506	36 883
1920	154 250	18 000	172 250	1975	10 947	29 509	40 447
1921	00 004	50 360	125 430	1976	13 117	29 548	42 665
1922	123 387	18 000	172 250	1977	7 512	35 495	43 007
1923	174 691	56 971	231 662	1978	4 802	31 542	36 344
1924	233 787	88 555	322 322	1979	15 554	36 114	51 668
1925	343 040	123 477	466 517	1980	—	36 500	—
1926	231 147	153 950	385 097				
1927	225 772	131 100	356 872				
1928	183 460	178 410	361 870				
1929	90 700	92 530	183 230				

Table 3. Age composition of harp seal females (in %) in pupping areas

Age, years	1963 г., 848*	1964 г., 775	1971 г. 446	1972 г., 460	1975 г., 481	1980 г., 432
4	4,6	1,5	0,2	—	—	—
5	12,5	14,2	3,6	4,2	0,8	0,2
6	18,4	17,4	3,2	2,8	4,1	1,2
7	14,6	17,8	7,3	7,2	10,2	2,9
8	12,7	12,2	5,0	4,6	15,3	5,7
9	9,8	8,2	9,2	7,2	2,7	5,9
10	8,6	7,1	8,8	8,3	7,3	8,4
11	5,6	5,2	7,3	8,1	6,2	8,4
12	3,5	4,1	6,3	7,4	5,6	8,2
13	3,6	3,5	6,3	7,4	5,6	5,9
14	2,2	3,1	6,4	7,2	4,6	1,8
15	1,9	2,2	5,6	5,0	4,6	5,3
16	1,2	1,2	5,0	5,0	4,8	5,7
17	0,4	0,9	4,7	4,2	4,8	5,5
18	0,2	0,4	4,7	3,7	4,4	5,3
19	0,1	0,4	4,1	3,5	3,3	4,4
20	—	0,3	3,4	3,2	3,7	4,2
21	0,1	0,1	2,1	2,4	2,5	3,6
22	—	0,1	1,3	2,2	1,9	3,4
23	—	0,1	1,7	1,9	1,5	2,5
24	—	—	1,5	1,7	1,5	2,9
25	—	—	0,8	0,8	0,8	1,8
26	—	—	0,5	0,6	1,0	1,8
27	—	—	0,6	0,4	1,0	1,6
28	—	—	0,2	0,6	0,8	1,0
29	—	—	0,2	0,2	0,8	1,0
30	—	—	—	0,2	0,4	0,6
31	—	—	—	—	0,2	0,4
32	—	—	—	—	0,2	0,2
33	—	—	—	—	—	—
34	—	—	—	—	—	0,2

* Number of individuals

Table 4. Size of White Sea harp seal population

Year	No. of breeding females in breeding areas, th.	Total size of stock in moulting areas	Year	No. of breeding females in breeding areas, th.	Total size of stock in moulting areas
1928	750,0—875,0	3,0—3,5 mln	1963	65,0	—
1937	—	600,0—700,0 th.	1968	70,5	344,0 »
1948	—	1,2 mln	1970	82,1	400,0 »
1953	—	1,3—1,5 »	1973	92,7	445,3 »
1959	117,0	1,2 »	1976	107,2	551,3 »
1962	—	240,0 thous.	1980		

Remarks. Method of determination - aerial survey. The exceptions are 1937 and 1948, for which estimates were made.